Students as Astronomers

Gaining new vision with the Mount Wilson telescope

by Jarrett Cohen

Thanks to Gil Clark (right) who gives schoolchildren access to the stars, National City student Gabriel Saldaña comes into school at night once every two weeks for astronomy sessions. Science magnet students have a total of 36 nights on the Mount Wilson telescope this year.

Edwin Hubble determined that the universe is expanding. Albert Michelson measured the speed of light for the first time. George Ellery Hale grasped that sunspots are huge magnetic fields.

These and many more of the 20th century's most pivotal astronomical discoveries were made at the Mount Wilson Observatory, a mile above Los Angeles. Today, students from around the world are using personal computers and modems (soon, the Internet) to control a 24-inch reflector telescope on the mountain, gaining first-hand experience with the modern tools of astronomy.

"Usually in science you learn what other people have done," said third-year observer Carina Marquez, a senior at the Crossroads School for Arts & Sciences in Santa Monica, Calif. With this telescope, "you can apply it. It is like being a real scientist; they delve deeply into all their own questions."

Making these explorations possible for Crossroads and 250 additional sites ranging from elementary schools to universities is Telescopes In Education (TIE), a joint effort of the NASA Jet Propulsion Laboratory (JPL) and the Mount Wilson Institute.

An idea born in the woods

Few members of JPL engineer Gil Clark's Boy Scout troop had a natural interest in science, but Clark worked it in through measuring heights and distances in the woods. Several boys earning astronomy badges inspired Clark to start building TIE.

A 1993 invitation from Mount Wilson director Robert Jastrow secured the telescope and dome. While the 24-inch telescope had ensured the solidity of the moon's surface for the astronauts in the 1960s and later became a training tool for Caltech graduate students, it lay dormant in storage for eight years. Equipment donations and volunteer renovators readied the telescope for remote observations.

"The hard work for me was getting the telescope on-line because I had only a few volunteers," said Clark, now TIE's director. Additions included a mounting with an electronic control system; an SBIG ST6 CCD (charged-coupled device) camera, whose sensitivity skirts light pollution from the Los Angeles basin; and specially designed versions of Software Bisque's TheSky and SkyPro packages. "Once NASA saw the interest, the funds came," Clark recalled.

NASA's High Performance Computing and Communications Program and NASA Headquarters' Office of Space Science pay for one-half of Clark's and JPL assistant Lori Paul's time and for full-time Mount Wilson chief operator Steve Golden, who runs the telescope in the earliest morning hours. For all other jobs "the volunteers took over," Clark said, about 100 of them doing fundraising, classroom lectures and much of the operations.

The volunteer operators come from all walks of life, and most had never used a research-quality instrument before. Several weeks' training from Golden readies them for the task. Barrett Duff, TIE project scientist, is a semi-retired energy consultant with 20 years in amateur astronomy. As a telescope operator, "you have to suggest objects for them to look at and suggest exposure times," Duff said. "I ask them questions, if they know what the object is and how far away it is, to see what they are interested in learning about it." Fellow operator Shelley Bonus, a writer and photographer, gleefully described their role as being "like astronomical dee-jays."

The night sky unfurled

TheSky software also is crucial for drawing up the schools' cosmological play lists. In a sky diagram, students click on their chosen objects, and the telescope slews to that region. Isidro Garcia, an eighth grader at National City Middle School near San Diego, showed off another feature: He entered "Pegasus" in a finder window, and a list appeared with all the deep sky objects around the constellation. SkyPro's image processing capabilities, which

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■ **Carina Marquez, Crossroads School**

Carina Marquez

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■ **Karen Prosser, National City Middle School**

photo ©Chris Wahlberg

schools spend the most time on, embrace a variety of false color schemes “to make things stand out,” said eighth grader Michael Grabau.

As in many developed TIE programs, National City students first must consult a catalog to get “the magnitude for the exposure time” and other information, explained science and math teacher Karen Prosser. In this third year of participation, 60 science magnet students are designing their observing runs around constellations. “The kids research constellations to determine where to look for particular space objects. So far, we’ve observed about 100 objects—planetary nebula, spiral galaxies, and as many other different objects as we can in each constellation.” she said.

Other students find themselves contributing to astronomical knowledge, occasionally even helping NASA. In 1995, seniors at Thomas Jefferson High School for Science and Technology in Alexandria, Va., “did a series of observations so they could more precisely pin down Pluto’s orbit,” said Lee Ann Hennig, Astronomy Laboratory director. Students then sent the data to JPL for designing the Pluto Fast Flyby mission.

Whatever approach they use, “most of these teachers and students come in on their own time,” said Bonus. National City students, for instance, will be at school until 10 or 11 p.m. for 27 nights during term and for nine Astronomy Camp sessions.

“TIE started out as a summer program at Crossroads” back in 1994, said W. M. Keck Math/Science Institute director Joe Wise, who secured private funds to pay the students, including several from other schools, in order to afford them a research experience in lieu of traditional summer jobs. “It got so big that we had to take it year-round” as an independent study course. TIE meshes with a growing collection of scientific instruments, including a donated

Gil Clark describes how students remotely control Mount Wilson’s 24-inch telescope via personal computers and modems. Internet access is being added this year.

Karen Prosser

scanning electron microscope. A $250,000 grant from the W. M. Keck Foundation of Los Angeles pulls these resources together into an integrated math/science curriculum, “for example, math classes looking at astronomy data,” Wise said.

Budding science careers are one result of this immersion. Crossroads’ Marquez intends to study biology, and two or three Jefferson TIE students major in physics or astronomy each year. Irrespective of vocation, “how people find information is going to be critical in the future,” Wise said. His students use books and journals but also contact scientists via electronic mail and search the World Wide Web for data. “We have bimonthly updates on our research on the Web [see http://kmsi.org],” said 12th grader Anne Hiura. “People contact us, and we make new connections.”

“The other thing is they have vision,” Wise added. “They see what might be as opposed to just sitting in the classroom. They see possibilities and start looking for answers.”

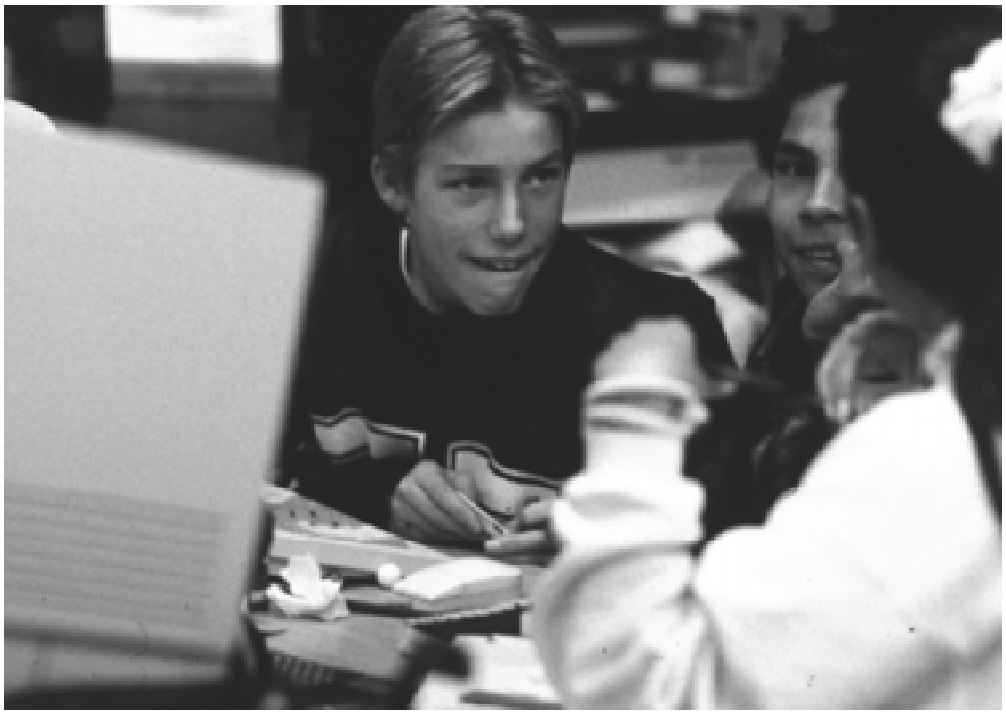
Broadening the experience

Recent telescope enhancements will improve the quality and increase the kinds of observational answers. TIE’s chief engineer Larry Smith, a JPL avionics engineer by day, has affixed a rigid mounting for more precise movement and a second layer of aluminum for better mirror reflectivity. Most important is his piggy-backing of a six-inch refractor with CCD camera on top of the 24-inch. With a refractor “you get better contrast and better planetary images and some deep space stuff,” Smith said.

“We want to image NASA’s Mars Pathfinder series and will follow Cassini” to Saturn, Clark said. The augmented telescope also furthers an opportunity for Crossroads to re-observe globular clusters studied by Allan Sandage of Pasadena’s Carnegie Observatories. Globular clusters comprise hundreds of thousands to millions of ancient stars, but 10th grader Aaron Parker explained that they are “concentrating on about several dozen to 90 variable stars within the clusters, plotting their light curves” to resolve their exact brightness. “You can get all of the images in two nights, but it takes you a long time to analyze them,” Parker said. Sandage helped to show that variable stars’ brightness translates into distance and thus is useful for pinning down the age of the universe.

TIE’s next phase will establish such collaborations on a more widespread basis. In SCHOLAR, for Students Conducting Hands-On Learning in Astronomy Research, “kids will work internationally, with a U.S. school teamed with a foreign school,” Clark said. “We will have a professional astronomer guide them. They will work as co-investigators and even publish.” Schools from Australia, Great Britain, Japan and Taiwan have participated on their own. Yet, in cross-national teams “they can learn about each other and other cultures...and have these links that weren’t there before,” he said.

Widening access to international telescopes is a twin goal. With instruments in Russia and Australia, for example, the scholastic teams could watch objects 24 hours a day, particularly “special events like

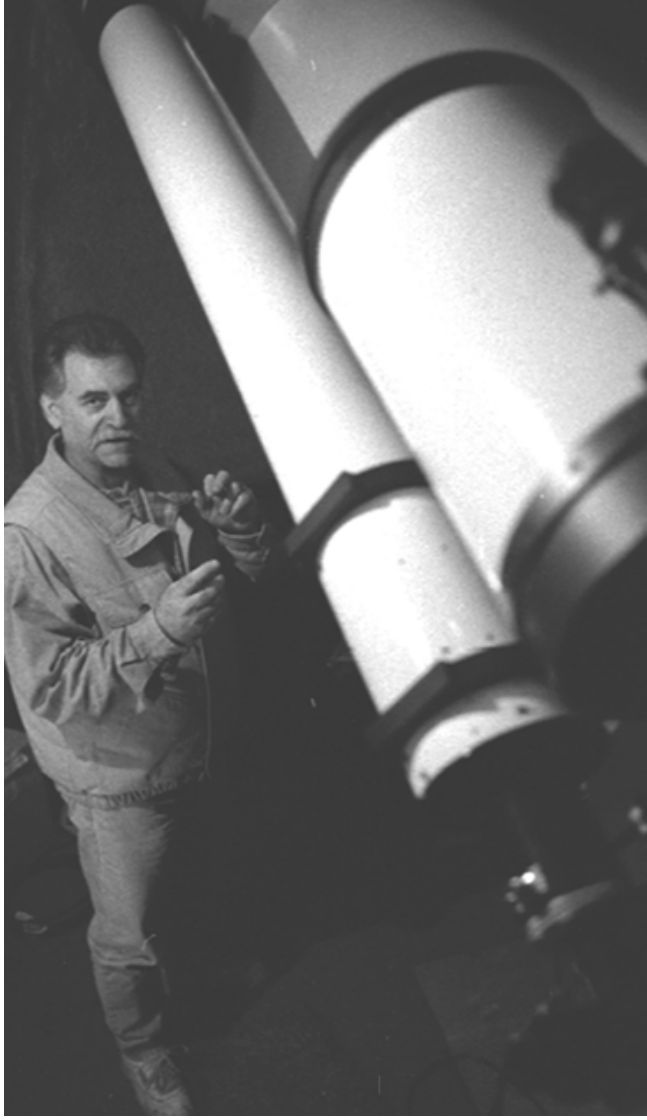


Left to right: Eighth graders Michael Grabau, Gabriel Saldaña and Melissa Pulido are among 60 National City (Calif.) Middle School students observing and imaging deep sky objects associated with constellations.

Joe Wise

supernovae and comets and asteroids, which have dynamics," Clark said. Also, "the kids could be on-line during the day," said Thomas Brennan, education technology consultant for Delaware. With the state wiring all its classrooms by the year 2000, Brennan will facilitate the schools "gathering data that is useful to somebody" through a Delaware State University course for teachers in astronomy and observing techniques.

Similarly, Wise envisions Southern California having a network of schools and research projects, with Crossroads possibly serving as a coordinator. "They could be studying things like earthquakes with seismometers at schools, air quality with electron microscopes and the ultraviolet and visible aspects of the sun with telescopes," he said. "I could see quite a few schools coming into the Internet to share resources." ■



Chief engineer Larry Smith (with telescope, above right) spent several months on telescope improvements, including placing a six-inch refractor on top of the 24-inch reflector for high-contrast planetary and deep space observations. Science teacher Joe Wise (right) discusses image processing with Crossroads School for Arts & Sciences tenth grader Aaron Parker (standing) and twelfth graders (left to right) Lindsay Weiss, Corinne De Coste and Anne Hiura. Crossroads has begun re-observing globular clusters studied by renowned astronomer Allan Sandage.

What do schools need to get involved?

Hardware

1. IBM or PC compatible computer: A 386 will work, but a 486 computer is preferable.
2. Modem: 9600 baud or faster.
3. Phone lines: At least one phone line to utilize the modem; a second is optional for talking with the telescope operator.
4. SVGA monitor and driver card: To supply resolution for effective image processing.
5. 4 megabytes of RAM: The software requires it.

Software

1. TheSky and SkyPro: Available from Software Bisque;
   912 Twelfth St., Suite A,
   Golden CO 80401;
   800/843-7599.
   Request the package designed for the Mount Wilson Telescopes In Education program.
2. Windows 3.1 or higher: To run TheSky and SkyPro.

Contact

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■ **Shelley Bonus, volunteer telescope operator**

Shelley Bonus

Rolex honors Clark

Telescopes In Education founder and director Gilbert Clark (right) was one of five 1996 "Rolex Awards for Enterprise" Laureates, receiving a $50,000 grant to further the program's goals. Clark received the honor for giving "schoolchildren in four continents access to the stars" and "making science exciting and fun for young people." There were 2,400 international entrants.